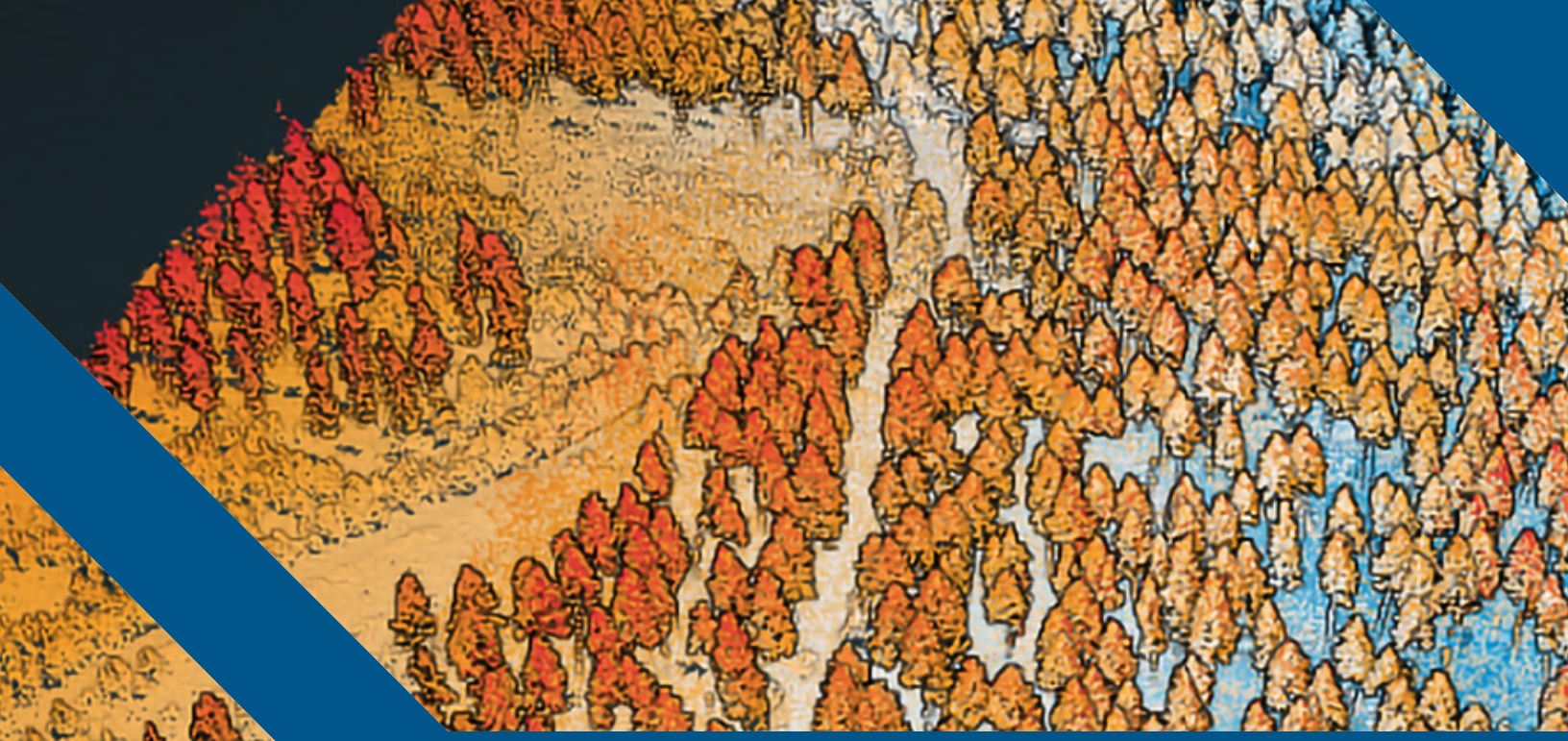
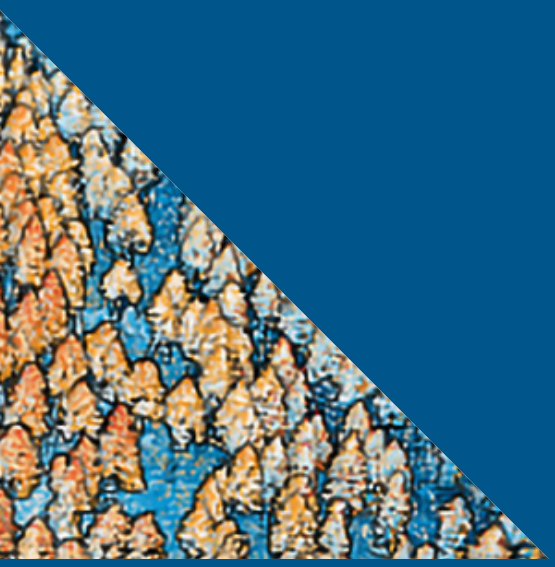
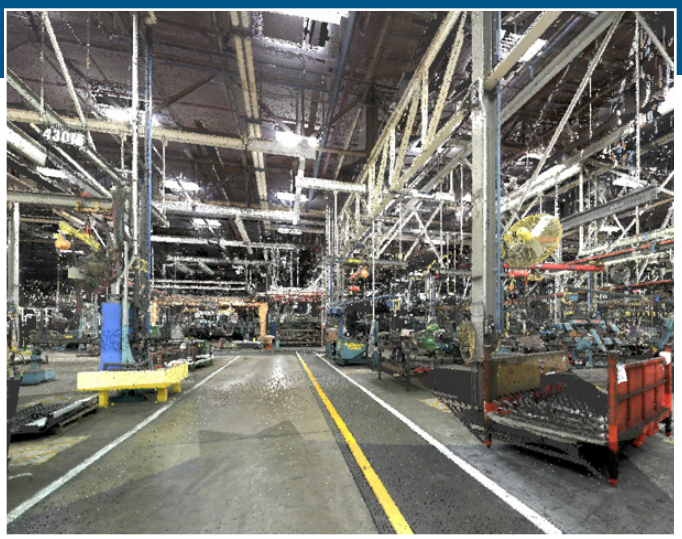


Reality Capture and Site Assessments:

MAKING THE MOST OF DATA

IMEG





New technologies for visualization and reality capture are expanding what the AEC industry can do when assessing a site—an often-arduous task that doesn't always capture the big picture or the small details. While photos and drawings can offer a small glimpse of an overall site, it can be challenging to visualize and understand how all elements relate to one another. This is where new advancements in reality capture can provide significant benefits to clients and design teams.

What is reality capture?

The term “reality capture” describes advanced methods of collecting visual and spatial information of a site (external and/or internal) to aid in visualization, obtain as-builts, build a digital twin, and create the foundation for design by importing the data into a CAD drawing or building information model (BIM). The data can be captured via a variety of tools, including drones, high-tech 3D laser scanners, utility locating equipment, and ground-penetrating radar (GPR).

“Using a combination of state-of-the-art reality capture technology, we can map out and take a three-dimensional look at the actual site, the lay of the land, buildings and other structures, and collect an immense amount of data,”

– Eric Vallejo

IMEG Director of Reality Capture and Geospatial Solutions

Owners can benefit from reality capture on virtually any type of site assessment project, including site security, hard-to-reach infrastructure inspections (like bridges, towers, roofs, underground utilities/structures, etc.), or measuring the surface area of a structure.

TERMS to know

While reality capture can take many forms and encompass many tools, these are the most common technologies and terms to know:

- **DRONES:** An unmanned aerial vehicle (UAV)—commonly called a drone—is a component of an unmanned aircraft system (UAS), which includes a UAV, a ground-based controller, and a system of communication between the two. IMEG's quadcopters are top-of-the-line unmanned aircraft, and pilots are certified under FAA Part 107. Many different payloads (cameras\sensors) can be attached to the drones to gather information through, photography, video, LiDAR and thermal technologies.
- **PHOTOGRAMMETRY:** This is a rendering process that stitches together photographs captured by the drone cameras to create a continuous map or 3D model along with all associated data.
- **DATA POINTS:** The X, Y, and Z coordinates of any point in space based on a fixed reference location. These coordinates are the essential elements of every map or scan.
- **3D LASER SCANNING:** A process using a laser and camera set at a fixed point or points to capture measurements (data points) of exterior structures or interior spaces to create a point cloud. 3D scanners come in handheld versions, tripod/rotating versions, and total station. Scanners that combine high accuracy measurements using traditional survey methods with 3D laser scanning are an ideal instrument for outdoor applications.
- **POINT CLOUD:** A product of the data captured by 3D laser scanners and drones. Once data is registered and processed, it may be translated into a 3D model utilized for the basis of design, volumetric analysis (for stockpiles and quarries), or measurements—e.g., the distance and relative location between any two points, such as the distance between one utility and another, one corner of a building to another, or one end of an air handling unit to another.
- **LiDAR:** Light detection and ranging is a sensor that can measure the amount of time laser light takes to hit an object and bounce back.
- **GROUND-PENETRATING RADAR (GPR):** This uses radar pulses to locate underground utilities and structures.
- **SUBSURFACE UTILITY ENGINEERING (SUE):** This involves multiple methods to locate underground utilities horizontally and vertically, including utility locating, manhole mapping, and other non-destructive methods, such as GPR.

Enhanced benefits for designers, architects, and owners

The visualization and reality capture provided by these various tools can provide accurate and current information about existing sites, buildings, lighting, and other elements quickly, safely, and cost-effectively. With such accuracy, the data provided can help owners with tasks like cost estimating and can capture visual components outside the scope of work or on adjacent sites. Additional benefits include:

- **Time savings:** An area that used to take days or weeks to manually map with a GPS or traditional survey can now be flown and mapped in hours or a few days, depending on the size of the project (200-acre campus could be mapped in less than four hours). Less time spent surveying at a worksite translates to cost savings for clients and helps speed up the entire construction timeline while eliminating the need for costly return visits.

- **Ease of access:** Drones remove the need to use expensive and time-consuming equipment. For example, instead of using a lift or floating in on a barge to examine the structure underneath a bridge section, a drone can be flown in to gather photos and data of minute details in hard-to-reach spaces. 3D scanners can even be used to measure the surface area of a structure, such as a water tower that needs to be painted, to calculate how much paint is needed before the project begins.

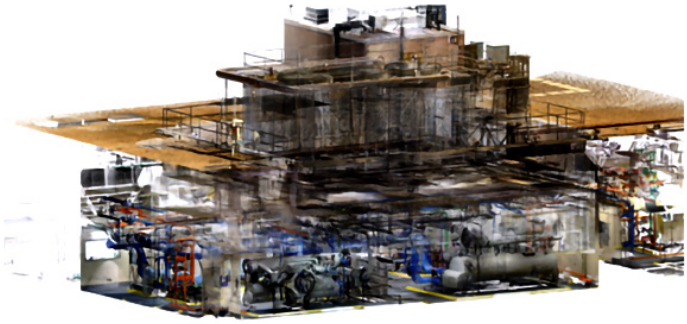
- **Increased data and accuracy:** The immense amount of data captured is extremely accurate and is always available for future extrapolation for other projects. Once a point cloud of onsite, roadway, or interior space is created, that information will always be available to reference. Reality capture offers engineers and architects a higher level of confidence in their design, knowing that the data was collected at a higher level of accuracy and detail compared to traditional methods.

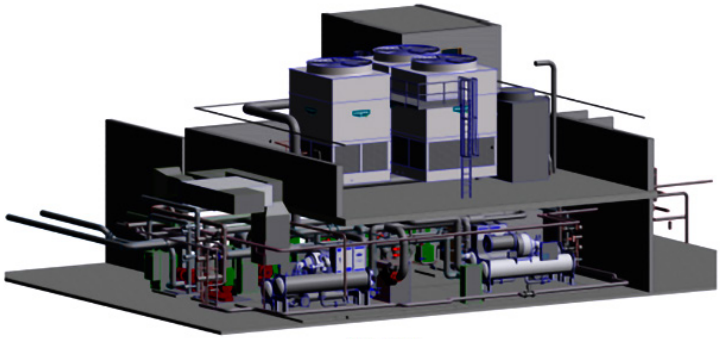
- **Safety:** Not only do these tools capture unprecedented amounts of data, they also provide safer work environments for surveyors, contractors, and client personnel. No one needs to venture into a potentially dangerous situation when a drone is available. (Construction and extraction occupations accounted for nearly half of all fatal occupational injuries in 2020, with fall protection leading the list of frequently cited OSHA standards violations.)

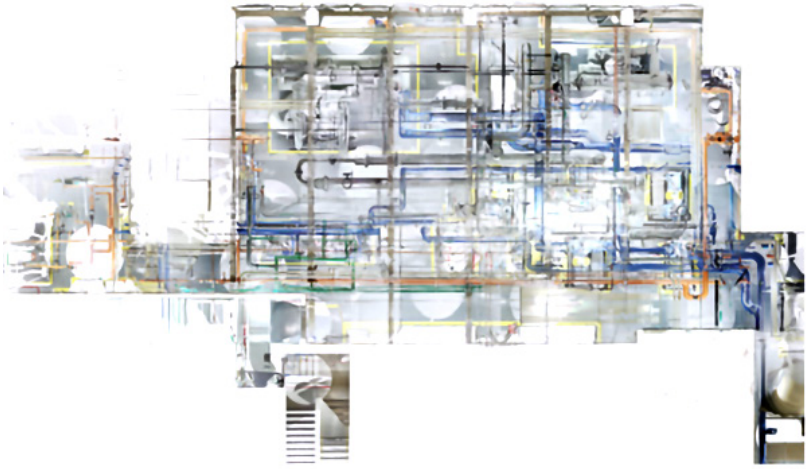
> “Basically, if you can see it, you can map it.”
>
> — Eric Vallejo

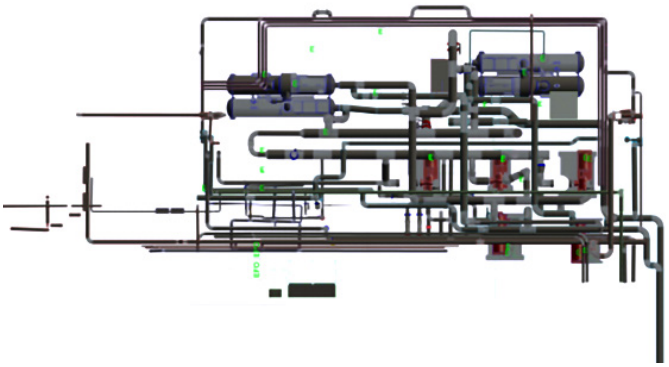
Reality capture benefits are not specific to one discipline; benefits can be gained through a variety of services, including mechanical, electrical, civil, survey, structural, and architectural. All of these methods increase the visualization of a site and can be used within a plethora of applications.

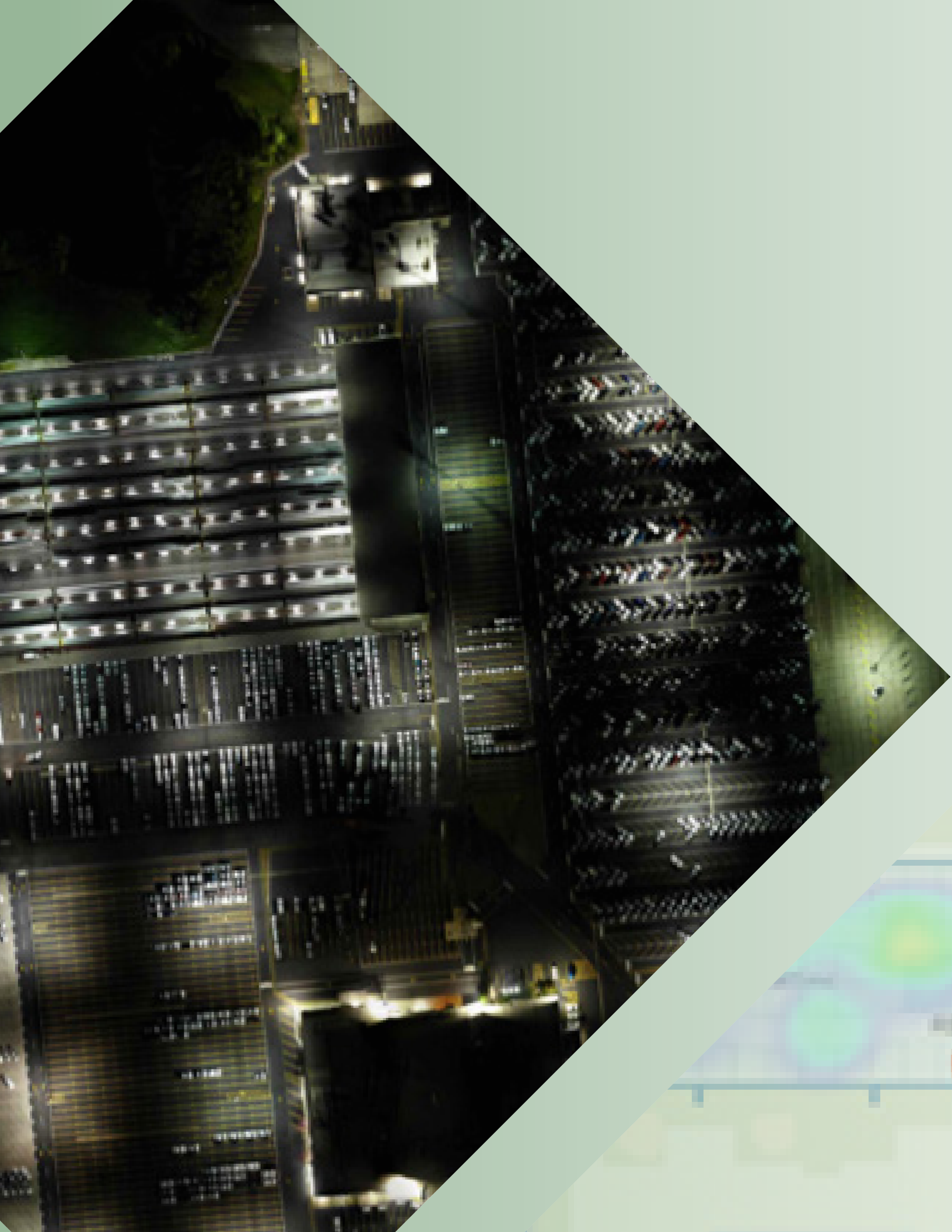
"Basically, if you can see it, you can map it," says Vallejo. "At IMEG, for example, our civil team works closely with our other disciplines, from structural to MEP, to create some incredible, information-rich models for clients in all markets."











New techniques and applications

The future of reality capture and mapping lies in autonomy, according to GIM International, which reports that robotic carriers (drones), laser-based sensors, and AI-based software are moving the technology forward. Innovations like FARO's new Hybrid Reality Capture, a first-of-its-kind scan mode that combines a static 3D laser scanner with colorized 360-degree photos and requires only 30 seconds per scan, is making the scanning process faster and more accurate. And AI-enhanced software can process otherwise unused data to provide more information quicker and at a higher level of accuracy, putting modeling on a path toward complete automation.

Using familiar technology in a new way is also pushing reality capture innovation forward. For example, conducting a site assessment by flying a drone at night can provide a new perspective on a site's lighting and security and any areas of vulnerability that may go unnoticed from the ground during the day. Data points collected from such an assessment can be used to create a 3D model for clients and design team members to help visually communicate the problem areas and how to improve them. (See sidebar for more information).

Improved equipment will provide an extra layer of safety for drone operations, as seen in new collision-tolerant aircraft. These caged drones are able to inspect confined spaces that are otherwise unreachable—such as vaults, caves/mines, utility tunnels, and within larger utility structures themselves—with the assurance that the drone and infrastructure within the space will not be damaged during the process.

Innovation ends the game of 'Frogger' at site assessments

IMEG conducted a night drone flight for a client in Denver to provide a lighting and security assessment addressing potential safety concerns.

The team conceptualized, developed, and built a tool consisting of a pole-mounted illuminance meter with GPS and a 360-degree camera used in conjunction with a drone to capture visual, spatial, and light measurements within the site. The team then leveraged GIS to combine the data collected and supplement reporting.

The results were highly visual and included a heat map of the lighting measurements, night-time aerial image overlay, and photograph locations. This method improved accuracy, visualization, efficiency, speed, and safety.

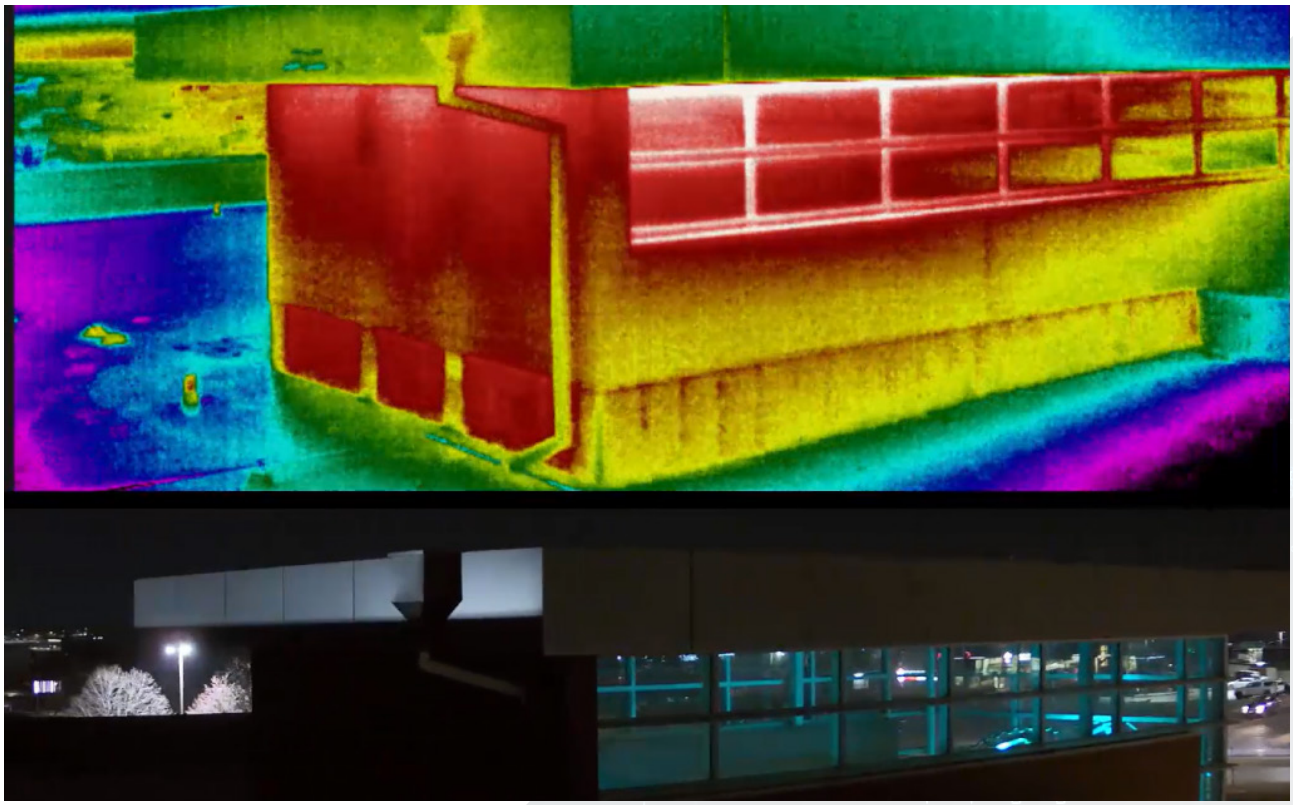
Listen to a podcast to learn more about this innovative technology.

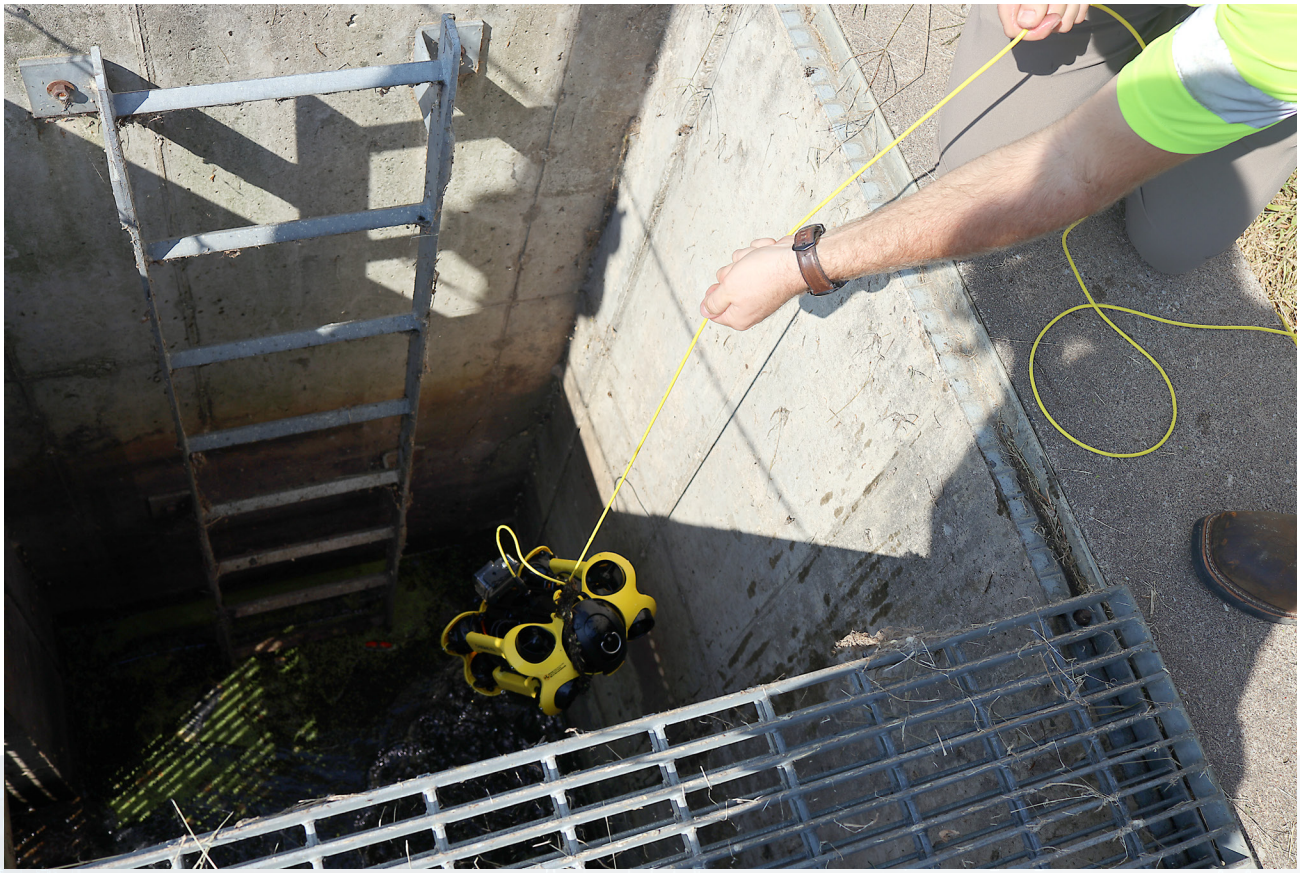
Thermal sensors are being increasingly used in tandem with drones to assess entire facades of buildings and rooftops to detect heat loss due to lack of insulation. They can also be used to assess any deficiencies within mechanical, electrical, and structural components. (See image below).

LiDAR-equipped phones are making the power of scanning available to more people. A variety of apps make it easy to scan virtually anything, from a whole room to mechanical systems. While these are no match for the powerful professional tools most firms use, their accessibility is opening the world of scanning and mapping to the public.

Using subsurface utility engineering to identify the existing infrastructure and creating a model that can be viewed in augmented reality can help reduce risk and the number of change orders by allowing construction teams and designers to see if the proposed design aligns with existing infrastructure. Indoor mapping systems provide ease of access for visitors to any type of building—from a large stadium or event venue to a commercial office building. Visitors can view the map through an app that shows them where they currently are and directions to where they want to go, much like Google Maps. These maps can assist response teams during an emergency, providing detailed room layouts with accurate and precise locations of a person's location inside a building.

Underwater ROVs (remotely operated vehicles) aid in underwater structural inspections, such as bridges, culverts, water treatment plant infrastructure, and more. The ROVs can be equipped with LiDAR and other sensors to take measurements underwater and provide additional information, eliminating the need for divers—saving time and reducing risk. (See image at right.)





"The uses of 3D scanners and drones are endless, especially when they're used together," Vallejo says. As these technologies become more commonly used in the AEC industry, owners and design teams will likely see increased benefits that make projects faster and more accurate.

Ever-evolving tech

Reality capture technologies are expanding the ways to serve client needs and opening up new opportunities to experiment with team collaboration and innovation.

"The new technology, software, devices, and uses for reality capture are constantly evolving and improving," says Vallejo. "It's an exciting time for our industry as we get to explore new ways we can provide innovative solutions."

For more information

Eric Vallejo
Director of Reality Capture and Geospatial Solutions • Technical Operations
309.793.3567
eric.l.vallejo@imegcorp.com

IMEG